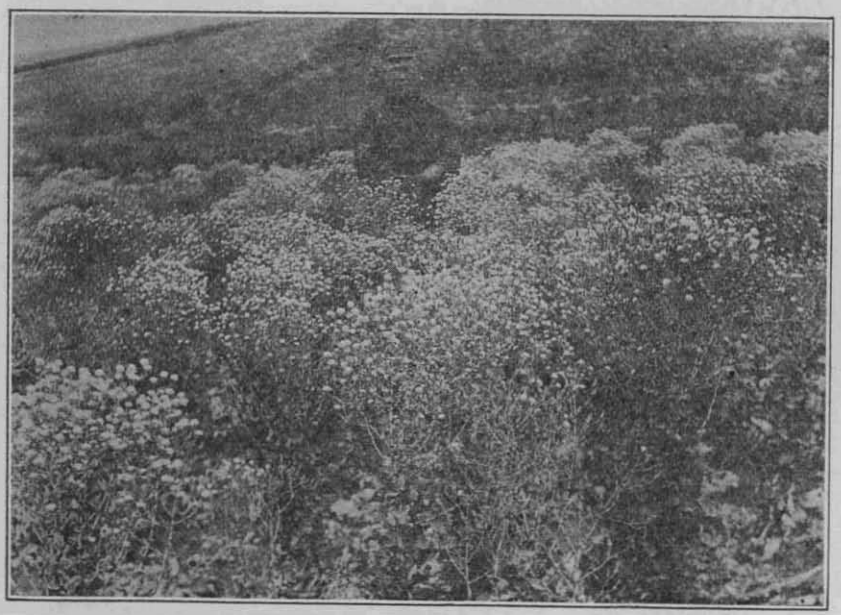
UNIVERSITY OF IDAHO
Agricultural Experiment Station

DEPARTMENT OF HORTICULTURE

Vegetable Seed Production in Idaho

By

C. C. VINCENT and L. E. LONGLEY



Growing Lettuce Seed in the Lewiston District

BULLETIN NO. 140 NOVEMBER, 1925

Published by the University of Idaho, Moscow

UNIVERSITY OF IDAHO AGRICULTURAL EXPERIMENT STATION

BOARD OF REGENTS

HUNTINGTON TAYLOR, President	Coeur d'Alene
STANLY A. EASTON, Vice-President	Kellogg
J. A. LIPPINCOTT, Secretary	Idaho City
CLENCY ST. CLAIR	Idaho Falls
MRS. J. G. H. GRAVELEY	Boise
ELIZABETH RUSSUM, Superintendent of Public Instruction, ex-officio	Boise
ETHEL E. REDFIELD, Commissioner of Education	Boise

EXECUTIVE COMMITTEE

STANLY A. EASTON — HUNTINGTON TAYLOR — ETHEL E. REDFIELD

A. H. UPHAM, Secretary

EXPERIMENT STATION STAFF

A. H. UPHAM, Ph.D.	President
E. J. IDDINGS, M.S.	Director

A. H. UPHAM, Ph.D.	President
HOBART BERESFORD, B.S. (Agr.E.)	Assistant Agricultural Engineer
H. W. HULBERT, M.S. (Agr.)	Agronomist
G. R. McDOLE, M.A.	Soil Technologist
F. L. BURKHART	Field Superintendent
C. W. HICKMAN, B.S. (Agr.)	Animal Husbandman
J. E. NORDBY, M.S. (Agr.)	Assistant Animal Husbandman
B. L. TAYLOR, D.V.M.	Veterinarian
W. M. GIBBS, Ph.D.	Bacteriologist
CHAS. C. PROUTY, M.S.	Assistant Bacteriologist
R. E. NEIDIG, M.S.	Chemist
R. S. SNYDER, M.S.	Associate Chemist
H. P. MAGNUSON, M.S.	Assistant Soil Chemist
W. B. BOLLEN, Ph.D.	Assistant Chemist
C. L. VON ENDE, Ph.D.	Associate Chemist—Apple Storage
F. W. ATKESON, B.S.	Dairy Husbandman
H. A. BENDIXEN, M.S. (Dairying)	Assistant Dairy Husbandman
G. C. ANDERSON, B.S.	Assistant Dairy Husbandman
F. G. MILLER, M.F.	Forester
CLAUDE WAKELAND, M.S.	Entomologist
C. C. VINCENT, M.S. (Agr.)	Horticulturist
L. E. LONGLEY, M.S. (Agr.)	Assistant Horticulturist
C. V. SCHRACK, B.S. (Agr.)	Gardener
*C. W. HUNGERFORD, Ph.D.	Plant Pathologist
*J. M. RAEDER, M.S.	Assistant Plant Pathologist
R. T. PARKHURST, B.S.	Poultry Husbandman
C. B. AHLSON, B.S.	Seed Commissioner
JESSIE C. AYRES	Seed Analyst
J. E. WODSEDALEK, Ph.D.	Zoologist
*A. E. McCLYMONDS, B.S. (Agr.)	Superintendent, Aberdeen Substation
D. A. STUBBLEFIELD	Superintendent, Caldwell Substation
W. A. MOSS, B.S. (Agr.)	Superintendent, High Altitude Substation
J. H. CHRIST, M.S. (Agr.)	Superintendent, Sandpoint Substation

*In cooperation with U. S. Department of Agriculture.

VEGETABLE SEED PRODUCTION IN IDAHO

C. C. VINCENT *and* L. E. LONGLEY

The production of garden seed has become an important industry in many parts of the United States. Up to the beginning of the World War our seedsmen depended upon European countries for a large part of their garden seeds. Many sources of supply were shut off during the war, and the acreage was greatly increased in older seed producing localities of the United States and new areas were developed. As a result production greatly increased, until the United States has a considerable surplus of vegetable seeds for export. With the exception of a few special crops the bulk of the garden seed now used in the United States is domestic output.

In Tables I to III are data taken from the 1923 year book of the U. S. Department of Agriculture, showing the acreage, production, and average yield of vegetable garden seeds in the United States for the years 1917 to 1922, inclusive. Table IV, taken from the same source, shows the imports of garden seeds for the years 1919 to 1922.

TABLE I

COMMERCIAL ACREAGE PLANTED FOR SEED IN THE UNITED STATES

Kind	1917	1918	1919	1920	1921	1922	Average 1917-1922
Beets—garden	826	2748	2666	400	380	633	1292
Beets—sugar	4638	6014	11139	7919	3699	1129	5756
Cabbage	737	974	1978	1135	636	730	1031
Carrott	1965	4622	3465	538	196	493	1879
Corn—sweet	12975	14759	14565	12024	4064	7405	10965
Cucumber	4694	3053	3582	3598	3577	4180	3780
Lettuce	1979	2291	2283	2010	1185	1929	1946
Onion	3782	7260	6730	2392	1108	1295	3761
Pumpkin	1512	1380	1156	2164	905	992	1351
Radish	3521	8760	10870	3396	1717	2485	5124
Spinach	1415	4259	1139	141	32	655	1273
Squash—winter	1328	2539	2912	2109	1310	836	1839
Turnip	24	936	1207	239	336	200	490

TABLE II

PRODUCTION OF GARDEN SEED IN UNITED STATES—In Pounds

Kind	1917	1918	1919	1920	1921	1922	Average
	1000 Lbs.	1000 Lbs.	1000 Lbs.	1000 Lbs.	1000 Lbs.	1000 Lbs.	1000 Lbs.
Beets—garden	464	2509	1858	118	180	429	926
Beets—sugar	5076	5900	6700	6770	3575	1056	1512
Cabbage	292	162	1383	157	224	368	431
Carrot	1129	2125	1562	291	76	183	894
Corn—sweet	8303	11917	13143	12870	4183	8749	9860
Cucumber	1026	548	766	580	487	707	685
Lettuce	903	747	680	587	310	856	680
Onion	980	1685	2618	801	334	450	1144
Pumpkin	108	133	110	247	106	119	137
Radish	621	1935	2537	614	258	743	1118
Spinach	300	1650	361	101	25	314	458
Squash—winter	93	128	443	255	144	66	188
Turnip	3	201	456	34	59	15	128

Garden seed production is a highly specialized industry. This is due largely to the fact that certain localities are adapted to the production of certain types of vegetable seeds. For example, most of the cabbage seed grown in this country is produced either in New York or Washington. Cauliflower seed production is restricted still more, for it is grown only on Long Island and on some islands in Puget Sound. Seed of cucumber, muskmelon and pumpkin is largely grown in Colorado and Nebraska; seed of sweet corn in New England, Iowa, and South Dakota. Turnip and rutabaga seed is grown mostly in Washington and California; garden peas in Wisconsin, Washington and Idaho; onion seed chiefly in California, Ohio and Connecticut; sugar beet seed in Michigan, Montana, Wyoming, Colorado, Utah, California and Idaho. California has long been noted for its production of such seeds as radish, lettuce, carrot, spinach, and garden beets.

This localization of certain crops is due to favorable soil or climatic conditions, or to a combination of the two. Some kinds of vegetables do not set seed, or at least do not produce paying crops, unless grown in a particular type of soil or under certain definite climatic conditions. The sugar beet and cabbage are good illustrations of this; neither will produce profitable crops of seed, except under very favorable conditions. As mentioned above, the cauliflower plant is still more limited than these two. It will produce seed only in a climate that is cool and humid at the time of seed setting and ripening. This type of climate is found on Long Island and on a few islands in Puget Sound. Certain European countries, as Holland and Denmark, also have these ideal conditions and we have always imported most of our cauliflower seed from these countries.

TABLE III

AVERAGE YIELDS PER ACRE FOR THE UNITED STATES—In Pounds

Kind	1917	1918	1919	1920	1921	1922
Beets—garden	562	913	697	295	474	678
Beets—sugar	1094	981	601	855	966	935
Cabbage	396	166	699	138	352	504
Carrott	575	460	451	541	388	371
Corn—sweet	640	807	902	1070	1029	1181
Cucumber	219	179	214	161	136	169
Lettuce	456	326	298	292	262	444
Onion	259	232	389	335	301	347
Pumpkin	71	96	95	114	117	120
Radish	176	221	233	181	150	299
Spinach	212	387	317	716	781	479
Squash—winter	70	50	152	121	110	79
Turnip	125	215	378	142	176	75

TABLE IV

VEGETABLE SEED—IMPORTED INTO THE UNITED STATES—In Terms of 1000 Pounds

Kind	1919	1920	1921	1922
Beet—sugar	9830	23446	7725	.....
Beet—all other	161	238	257	272
Cabbage	169	391	253	181
Carrot	16	69	48	37
Pumpkin	44	17	57	40
Radish	112	320	213	272
Spinach	367	1139	1122	1927
Turnips and Rutabaga	1810	1847	2242	1360

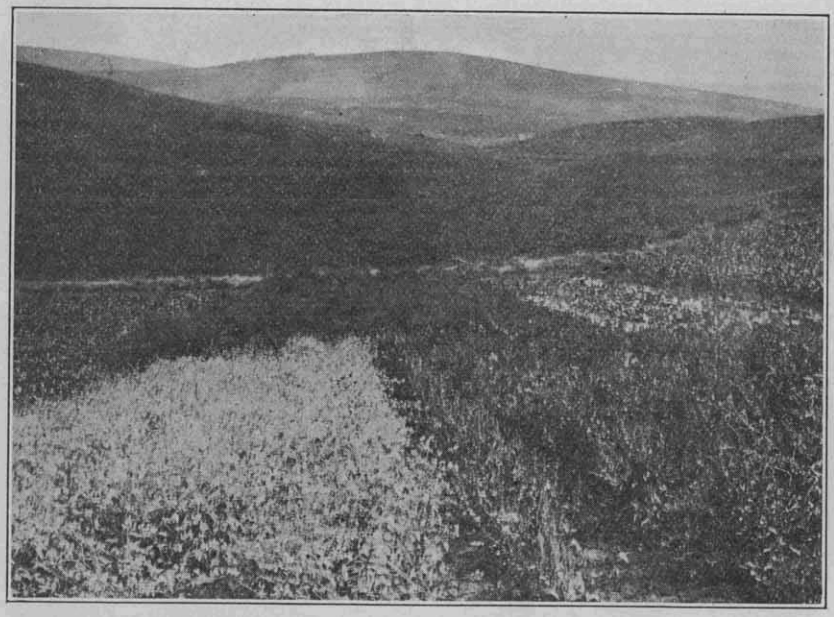


Fig. 1—General View of Experimental Seed Plots.

Certain parts of Idaho can profitably produce some types of garden seeds. This especially is true of the northern portion of which the Palouse country is typical. For several years the horticultural department of the Idaho Agricultural Experiment Station has been conducting experiments in the growing of seeds of several kinds of vegetables, including cabbage, sugar beets, garden beets, carrots, turnips, spinach, radish, lettuce, cucumbers, pumpkin, squash and sweet corn. This bulletin brings together the results of these investigations, which covered a period of six years, relating to the methods of seed production, yield, harvesting and cleaning.

BIENNIAL VEGETABLES

Biennial vegetables are those which require two years to produce seed —the root, bulb or head is grown one season, usually dug and stored over winter and the following spring is planted and produces seed. This means that the ground is occupied by one crop for a period of two seasons. Considerable work is involved in digging, storing and replanting the roots. A few biennials such as parsnips and salsify may be left in the ground over winter and much labor can thus be eliminated. Others, such as onions, require a different method of winter storage.

For several years experiments have been conducted with garden beets, sugar beets, carrots, turnips, and cabbage in order to get data on the best cultural practices, time of planting, and method of wintering over. Four methods of treatment were used:

1. The roots or plants were grown by planting seed in the spring, growing plants to good size, and digging and storing them in pits over winter.
2. The plants or roots were grown as in method No. 1, but were left in the ground over winter. In the case of cabbage, dirt was plowed over the rows so as to nearly cover the heads. This dirt was raked from around the heads in the spring. In some cases, the roots crops had dirt plowed over them, or they received a coating of manure or were left with no covering. In the spring some cultivation was given.
3. The seed was sown in mid-September and the plants were left in the field. They made some growth during the fall but usually had only three or four leaves by winter time. The seed was sown thickly to insure a good stand. In early spring, the plants were thinned to about six inches apart and given good cultivation.
4. The seed was sown in mid-September in cold frames, which were covered with sash as cold weather approached. In the spring, the small plants were transplanted under the same conditions as were the larger roots from the pits. The advantage of this method is the elimination of work connected with handling, sorting, and planting the large roots. On the other hand, it involves considerable initial expense for hotbed sash and some labor in preparing and planting the frames.

Table No. 5 shows the results with several of these biennial crops for a series of years.

TABLE V

YIELD OF SEED OF BIENNIAL VEGETABLES—Idaho Experiment Station

Kind of Seed	POUNDS PER ACRE						
	1919	1920	1921	1922	1923	1924	Average
Turnip—Sown mid-September, wintered in ground	.....	.....	2153	1690	2860	750	1863
Turnip—Sown mid-September, in frame	.....	1200	A	550	.....	.....	865
Carrot—Sown in spring, roots wintered in pit	.....	400	490	700	.....	.....	530
Carrot—Sown in spring, roots wintered in ground	.....	.....	B	C	887	.....	.....
Carrot—Sown mid-September, roots wintered in ground	.....	333	B	.....	.....	.....	.....
Beets—Garden—Seed sown in spring, roots wintered in ground	.....	B	386	F	.....	.....	.....
Beets—Sugar—Sown in spring, roots wintered in pit	1384	E	455	E	2893	618	1360
Beets—Sugar—Sown in spring, roots wintered in ground	.....	B	1698	C	.....	.....	.....
Beets—Sugar—Sown mid-September, roots wintered in ground	.....	D	1830	D	.....	.....	.....
Cabbage—Wintered in pit	412	533	.....	.....	.....	.....	472
Cabbage—Wintered in ground	.....	.....	160	F	.....	.....	.....
Cabbage—Stump heads having been removed, wintered in pit	144	F	.....	.....	.....	.....	.....

A—No yield. Plants were so large at setting time that they died.
B—Roots failed to winter over.
C—Roots dug.
D—Roots failed to produce a crop.
E—No yield because of diseased roots.
F—Experiment discontinued because of low yields.

BEETS

The beets differ somewhat in type but require practically the same conditions for the production of seed. Types are: 1. Garden Beets; 2. Half-sugar or Mangels; 3. Sugar Beets.

The yields of seed of these types vary somewhat. For example, in 1922 in the United States, the average yield of sugar beet seed per acre was 935 pounds, of mangels 911 pounds, and of garden beets 678 pounds.

Sugar beet seed production in the United States on a large scale is a relatively new industry. Only a few acres produced seed in 1914; by 1919, due to war conditions, 11,139,000 pounds were produced. This fell to 1,129,000 pounds in 1922 due to the competition of European countries. In 1922, the United States produced 112,000 pounds of mangel seed and 633,000 pounds of garden beet seed.

Small roots, not over 16 ounces in weight, usually are used in com-

mercial seed production. Experiments have shown that the size of the root, with the exception of weights below 2 ounces, does not greatly affect the yield of seed per acre. In view of the fact that a larger number of roots of this small size can be grown on a given area of ground and because of the greatly reduced labor involved in digging, storing over winter and planting out in the spring, these small roots or "stecklings" are used almost invariably in commercial beet seed production. Their size will average from ½ to 1½ inches in diameter, with some ranging a little larger.

Fig. 2—A Sugar Beet Plant.

Growing the Stecklings: Twenty to 25 pounds of seed are sown per acre in wide drills. A special shoe which spreads the seed over a wide space is used on the planter. This makes it possible to grow more roots to the row. Rows are spaced about 18 inches apart. Later the stecklings are thinned to an inch apart. Enough roots will be grown on an acre to plant about 10 acres the next year. The stecklings mature early because of the thick planting, can be dug earlier, and will keep better thru the winter.

Storing the Roots: In a climate, such as is found in the Palouse country and some other sections of Idaho, the method of storage in pits is the

most satisfactory. The roots should be dug before freezing weather sets in, usually from the middle of October to the first of November. A pit is dug one and one-half feet deep and about four to six feet wide, depending on the amount of roots to be stored. The roots are piled in this trench up to a height of two feet or more above the ground. A heavy layer of straw should then be placed over the roots and earth plowed or shoveled over the pile, covering it to a depth of one foot or more. Because of the danger of heating, it often is necessary to provide some kind of ventilation. This is especially true if roots are pitted during warm weather in the fall. For this purpose, bottomless boxes 12 to 18 inches square filled with straw, set at intervals along the top of the pile before covering, are effective in providing ventilation. As cold weather approaches, these boxes may be replaced with dirt. If winter temperature for some time remains at zero or below, more dirt should be covered over the pile, or manure may be put on after the ground starts to freeze. More protection can be secured by digging the pit deeper to place practically all the pile of roots below the surface, and by increasing the depth of earth covering up to 30 inches. In sections where the ground often freezes three to four feet in depth, the roots should be stored in cellars. Shrivelling may be prevented by alternating with layers of soil or by throwing a layer of soil over the beets in the bin. Cellars, such as are made for storage of potatoes, are satisfactory, especially if made so that a wagon can be driven through the center of the cellar. In the case of large roots, the tops are removed before storing, care being taken not to remove the center bud of the crown. Often the stecklings are dug and stored with the tops on. Sometimes the topping is done by running a mowing machine over the field before digging, the sickle being set so as not to cut the crowns.

A well-drained spot should be chosen for the pit, preferably on the side or top of a hill so that the water will readily drain away. It is often most economical to place the pit in the field where the roots are grown, merely gathering the roots from adjacent rows into a pit or pits extending the length of the field. In the spring when the roots are removed from the pits all diseased ones should be discarded. Where only the tip of the root is rotted, this decayed portion should be cut way before the root is planted. All roots not of the proper color or shape, or differing in any way from the type being grown should be discarded. Accurate judgment of type of steckling is difficult, aside from color and general form. For that reason, the stock seed used for the growing of stecklings is selected carefully for several generations, being grown from full sized beets rigidly selected for type. Inasmuch as only one generation intervenes between this stock seed and the commercial seed, there is very little chance for the introduction of impurities.

Planting the Roots: The stecklings should be planted as early as possible in the spring. Maximum crops are rarely obtained from late planted beets. The ground should be worked so deeply that the steckling may be planted with ease. The roots are commonly planted in rows 3 feet apart and 1½ to 3 feet in the row depending on whether they are large, medium or small in size. The smaller ones are set closer together. Planting usually is done by using a round dibber or crowbar to make the holes. Often a long handled spade or shovel is used, especially if larger roots are being planted. The root is inserted into the hole and the dirt pressed firmly around the root with the foot. The crown should be set at about the depth it grew or a little lower. In ground inclined to crust,

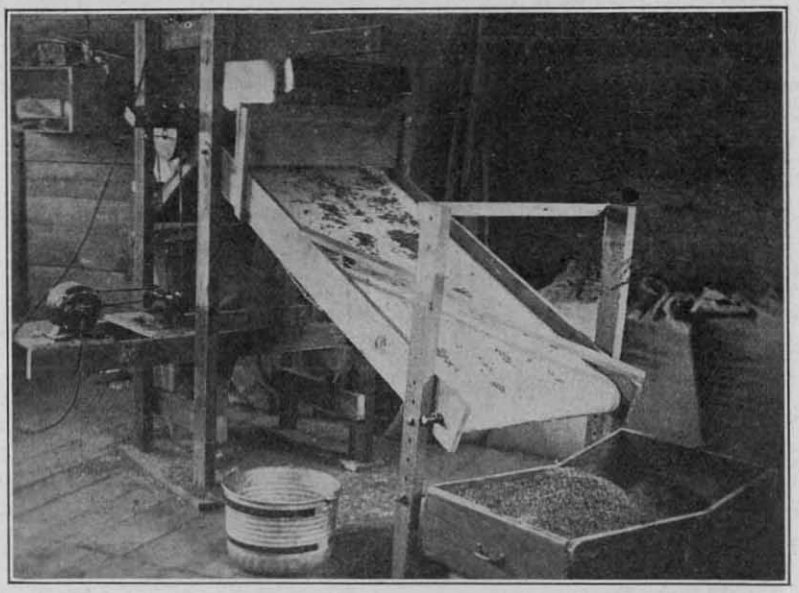


Fig. 3—A Beet Seed Cleaner.

care should be taken not to cover the crown deeply. The same culture is given as would be required for corn or any similar crop.

The seed should be harvested before the stalks become dry to avoid loss from shattering. In fact, the harvesting should be done before the seed balls on the ends of the branches have turned brown. The date in Northern Idaho usually is about the middle of August. The beet stalks ordinarily are cut by hand and either tied in bundles or laid in small piles, the butts all pointing the same way. In a rainy country, small bundles are made and shocked upright. If the seed has become rather ripe, considerable shattering can be prevented by cutting only in the early morning when the stalks are tougher because of the dew. The seed

is threshed when fully dry. On a small scale, it can be flailed out. A threshing machine handles it well if the cylinder speed and the wind are somewhat reduced, and proper sieves are used. Beet seed will not thresh readily during damp weather and in humid sections can only be threshed satisfactorily on dry days.

Beet seed is difficult to clean. After threshing, it should be run thru a fanning mill several times until most of the foreign material is removed. Many pieces of broken stems will remain with the seed and these can be removed only by a special beet seed cleaner—a canvas apron set at a rather steep angle—on which the seed is fed, as shown in Figure IV. The apron moves upward over rollers and carries the sticks over the top allowing the seeds to roll down the apron into a box below.

As seen from Table No. 5, some success has been had in producing sugar beet seed by the method of sowing the seed in the spring and wintering the roots in the ground. In most years, however, the roots have failed to winter over well enough to give a yield of seed. When the method of sowing the seed in mid-September and wintering in the ground was used, the roots usually did not winter well enough to give a yield of seed.

Results were unsatisfactory generally when the seed was sown in a frame in mid-September and the plants set in the field in the spring. Many of the plants either did not form seed stalks or formed them so late in the season that the seed did not ripen satisfactorily.

CABBAGE

Cabbage differs from most other biennials in that the above-ground part of the plant is the storage place for the beginning of the second season's growth. Because of this, storage conditions differ slightly. In the Puget Sound region, the young plants are set out in the summer. As cold weather approaches dirt is plowed over the heads for protection. One plan often followed is to plant the rows 3 feet apart and just before plowing to take out each alternate row. The poor heads in the remaining row are then eliminated and the vacant spaces are filled by good heads. This leaves 6 feet between rows for development of seed stalks the following year. The cabbage plant grows very rank and branches profusely when grown for seed in that climate, and this space is necessary to harvest the crop satisfactorily.

While this method may be used in parts of Idaho, it is seemingly not the best system. Too many heads rot or fail to grow in the spring. The seed yield for 1921 shown in table No. 5 was secured from heads wintered over in the ground, while yields for the other two years were results of wintering over in pits. In pitting, a shallow trench wide enough for

three or four heads to stand side by side, is dug. This trench may be opened by plowing two furrows away from each other. The first row of three or four cabbages is laid obliquely against the soil at the end of the trench, with the roots downward. Each successive row is laid obliquely against the one preceding. Soil is then plowed or shoveled over the pit to a depth of from six to twelve inches. In the spring the heads are taken out, rotten leaves are trimmed off and the heads are set in the field three feet apart each way.

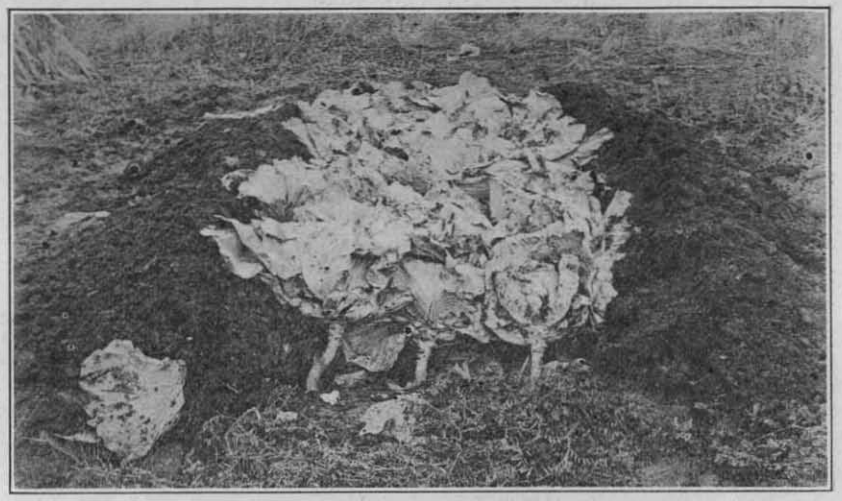


Fig. 4—Pitting Cabbage.

Since cabbage seed ripens unevenly it is advisable, especially when the crop is grown on a small scale, to go through the field several times to harvest stalks that are ripe. In producing on a large scale, it will be necessary to harvest the crop before all of it is entirely ripe. If the bulk of the pods are well ripened, the ones at the tips will ripen up after harvesting. The seed is harvested and threshed in the same manner as turnip seed is and requires the same or greater care in handling to prevent loss through shattering.

As is indicated in table No. 5 cabbage seed can be produced from stumps from which heads have been removed. This probably would not be profitable commercially, although it might if the stumps are spaced closer in the row. This method sometimes is used to get seed for planting from superior heads, at the same time marketing the head. For the market gardener, who understands selection, it should be a profitable procedure. Stumps are wintered over in the same manner as the heads are stored, and are handled in the same way in the spring.

The yields obtained at the Experiment Station are much lower than

are secured in the Puget Sound region where yields of 1,000 pounds or more per acre are common. *The average yield for the United States during the past two years is 418 pounds per acre and the yield varies from 138 to 699 pounds. The average annual production in the United States for 1917-1922 is 431,000 pounds. During the years 1918-1922, the production, due to the effects of the war on seed growing in Europe, was much greater as was the case with most garden vegetables.

*Average yield represents the average production divided by average acreage for years 1917-1922 inclusive.

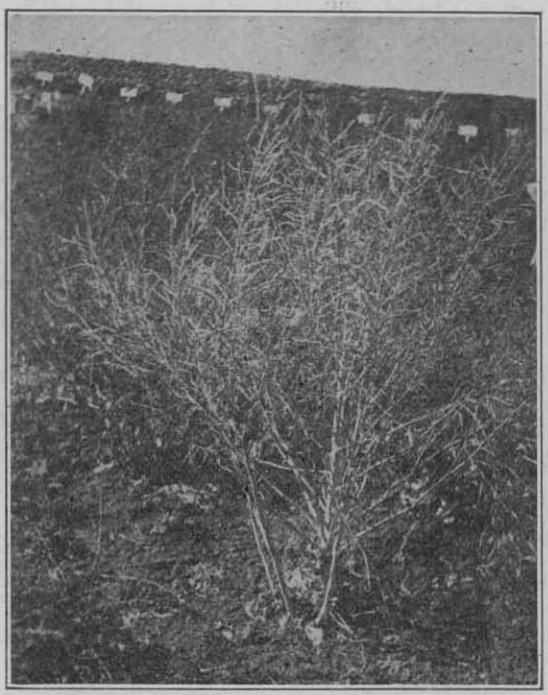


Fig. 5—Seeding Plant of Cabbage.

CARROTS

The growing of carrot seed differs from the growing of beet seed chiefly in that for the commercial crop normal-sized roots are used. The grown roots are topped and wintered over as beets are. Before planting, they should be sorted and any that show variation from the type discarded. They should be planted in rows three feet apart and from one to two feet apart in the row, with the crowns set even with the surface and the earth pressed firmly about the roots. When the bulk of the seed clusters are ripe, which is shown by drying of stalks and the seed cluster

turning brown, the crop should be harvested. Carrot seed, unless very much over-ripe does not readily shatter, and it is, therefore, easier to handle than beet, turnip or parsnip seed. The stalks are usually cut by hand and are either bound into bundles or laid one way in small piles. When dry, the seed should be threshed in a threshing machine. It should not be flailed out unless a machine is available to take off the hairy beard on the seed. In a threshing machine, this beard is fairly well removed. The seed is cleaned in a fanning mill. It is difficult to get thoroughly clean, rather delicate manipulation of the wind being required because of the winged characters of the seed.

In experimental work during 1920, a fair yield was obtained by sowing seed September 15 and wintering the plants in the ground. Usually, however, it is not easy to get a good stand at this time of year and carrots will not winter over as readily as turnips.

In 1923, a good yield was obtained by wintering over in the ground roots produced from seed sown in the spring of 1922. In other years carrots have not wintered over well enough by this method to give a stand which would produce seed. The average yield for 1922 in the United States was 371 pounds per acre. The total production was 183,000 pounds.

ONIONS

In growing onion seed the first year procedure is the same as that pursued in growing ripe onions. After the bulbs are grown, either one of two methods of producing the seed may be followed. A common practice where winters are not too cold is to plant the bulbs soon after pulling. As cold weather approaches, dirt is plowed over the rows. The other method is to store the bulbs over winter in a storage house where the temperature is above freezing but not very high, and where the humidity is low. In either case, the onions are sorted so as to remove off-type bulbs. The bulbs which should be set out as early in the spring as possible are placed in rows 3 feet apart and 6 inches apart in the row. A row can be opened with a one-shovel plow, the bulbs set in, and the row covered by hand or with a two-horse cultivator. The covering should be fairly deep. If set too shallow, the seed stalks may fall over as the seed matures.

When the heads turn yellow and the seed begins to shell out, it should be harvested. It is better to cut before the whole head is entirely ripe. If the whole seed stalk is cut with the head, the seed will mature considerably after cutting, although the common practice is to cut with only a small part of the stalk attached. Several methods of curing on a small scale are widely used. The heads may be cut with some stalks attached, tied into bundles and hung on wires stretched over a tight floor or cloth

in a shed more or less open. Another good practice is to spread the cut heads on shelves of wire screen in an open shed. Again the seed may be cut and placed in piles on a cloth to dry for a day or two in the sun and then removed to an open shed and spread thinly until dry. Threshing may be done by flail, but use of a threshing machine is preferable. The seed is then run twice through a fanning mill. Formerly it was washed in a tank of water, was spread thinly on cloths in the sun and was stirred frequently to give uniform drying. When thoroughly dry, a final cleaning with the fanning mill was usually necessary. Because of the danger of injury to seed, this method now is seldom used as improvement in ma-

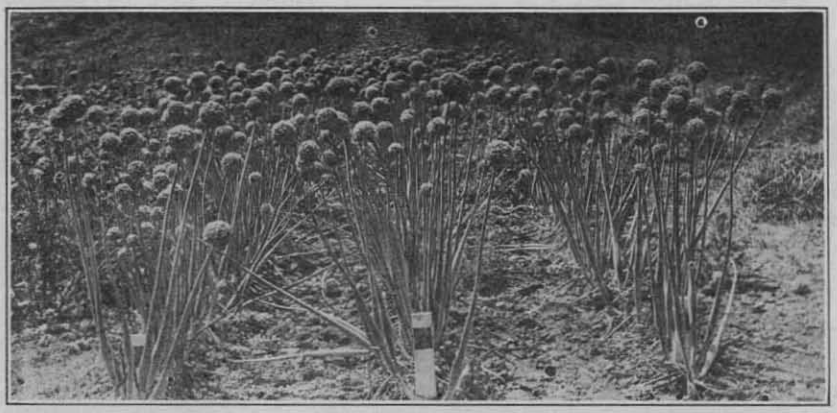


Fig. 6—Planting Onion Bulbs for the Seed Crop

chinery has made it possible to clean well without resorting to the old measures.

The onion differs from the sugar beet in that the size of the bulb planted greatly influences the yield of seed. This is indicated in table No. 6.

TABLE VI

YIELD OF RED WETHERFIELD ONION SEED PER ACRE FROM BULBS OF DIFFERENT SIZES

	POUNDS PER ACRE		
	1919	1920	1921
Small Bulbs	160	166	420
Medium Bulbs	354	500	560
Large Bulbs	535	611	630

The approximate size of the bulbs is indicated in data for 1921. The small bulbs which were somewhat larger than large onion sets, required

2904 pounds to plant an acre. Medium sized bulbs required 5324 pounds per acre, and large sized ones 9680 pounds. The yield per acre in the United States for the last four years has averaged between 300 and 350 pounds per acre. The total yield for 1922 was 1,295,000 pounds.

PARSNIPS

Parsnip seed is sown in early spring, in rows three to four feet apart. Later the plants are thinned to six inches apart in the row. During the growing season they should be kept well cultivated. Since the parsnip is hardy, roots are left in the ground over winter. In early spring of the second year, good cultivation should be given until the foliage shades the ground enough to prevent growth of weeds.

Seeds are produced in heads, two seeds being formed together flat against each other. When these begin to separate the seed is ripe. It is often necessary to go over the field more than once to cut the early

Fig. 7—Onion Seed Ready to Harvest.

maturing seed, in order to prevent shattering. When the bulk of the seed is well browned, stalks are cut, laid in piles on cloths, and exposed to the sun for a few days. When dry, this is threshed with flail or threshing machine and then the seed is spread out on the cloth and allowed to lie for several weeks until perfectly dry.

Parsnip seed cannot be grown where the wild parsnip is abundant, as these will mix. In some localities, the parsnip web-worm is a pest. Spraying several times with lead arsenate will help to control it. If the web-worm becomes very bad, it might be best to discontinue growing parsnip seed for a few years to reduce the number of worms.

In a good year, parsnip seed will yield from 500 to 800 pounds per acre.

SALSIFY

Cultural methods are the same as for parsnips. The salsify seed harvest extends over a long period of time. Heads are usually hand picked as the seed soon shells out if left on the plants. They are gathered and spread on a sheet or canvas to dry. They may be threshed in a threshing machine, or by running a roller over the heads, or by flailing. The seed is cleaned in a fanning mill. It should not be stored until thoroughly dry. The yield of seed per acre for salsify varies from 250 to 450 pounds on the average. In 1922 the United States produced only 33,000 pounds.

TURNIPS

Where practicable, turnip seed should be grown from roots wintered over in the ground. In colder sections, this is not possible as roots will not withstand severe freezing. Where such conditions prevail seed should be sown in late July and the roots dug before hard freezes occur, usually in late October or early November. The roots are then pitted as described in the section on sugar beets. If the ground freezes deeply, considerable protection will be necessary, but turnips usually will come through better than beets unless the crown has been severely frozen before digging. In the spring roots are set out in rows three feet apart and 18 inches apart in the row. A hole is made with a spade or dibber and the earth is pressed firmly around. The crown is left slightly above the surface of the soil.

If roots are wintered over in the ground, there are two possible methods of procedure.

1. Seed is sown in late July or early August, and by late fall full grown roots are produced. About the end of October, earth is plowed over the rows for protection during winter. In the spring, some harrowing or raking may be necessary to enable shoots to break through. This method is practicable where there is sufficient moisture to germinate the seed at sowing time. It is also desirable in sections where some protection is necessary during winter. This method is used in the Puget Sound region and similar sections in the United States and in Europe.

2. If seed is sown about September 15, in sections having a climate similar to that of the Palouse, no winter protection is necessary. Experiments conducted have shown that good results are obtained by this method as indicated in table No. V. Seed is sown rather thickly in rows three feet apart. The plants make a small growth before cold weather sets in and at times during the winter as weather permits. In the spring,

plants are thinned to four inches apart and are cultivated a few times. The roots do not develop to any size, but the plants at once shoot to seed and in a favorable year make a luxuriant growth. With this method, no attention can be paid to rogueing. Dependence is placed rather in having stock seed that is pure and that can be relied upon to reproduce good seed without rogueing for the one generation. To produce stock seed, roots are grown to full size, dug in the fall and carefully sorted before pitting. Only roots of the very best type should be used as mother roots.

Owing to the ease with which seed shatters from the dried pod, the mature seed stalks are cut most efficiently by means of a sharp hand sickle or shears. It is not necessary to wait until all pods are ripe. If the majority of the pods on the stalk are yellow, those at the tip will mature after the plants are cut. Cut stalks should be placed in small piles,

Fig. 8—A Heavy Crop of Turnip Seed.

butts all placed one way. It is desirable to have squares of canvas or building paper under piles to prevent loss of seed. They should be left to dry a week or more before threshing. Turnip seed may be threshed in a threshing machine or it may be flailed out easily as the pods are very brittle. The wagon box in which seedstalks are hauled from the field should have a canvas in the bottom to catch the seed that shatters out. The seed is easily cleaned in an ordinary fanning mill.

ANNUAL VEGETABLES

This group includes plants which produce seed in one year. The experimental work has dealt with sweet corn, cucumbers, lettuce, radishes, spinach, pumpkins and squash. In the case of radishes there is also a biennial type, the winter radish. Spinach, too, is somewhat of an exception in this group in that seed can also be grown in a manner used for some biennials. Tables Nos. VII and VIII show the yields of seed obtained from annual vegetables over a period of several years.

TABLE VII

YIELD OF SEED OF ANNUAL VEGETABLES—Idaho Experiment Station

Kind	POUNDS PER ACRE						
	1919	1920	1921	1922	1923	1924	Average
Sweet Corn—							
Golden Bantam	.....	1400	.....	1012	1186	.....	1199
Idaho Snowball	.....	.....	.....	2420	2580	.....	2500
Cucumber—							
Boston Pickling	200	.....	.....	.....	.....	.....	.....
Lettuce	153	.....	.....	.....	.....	143	148
Radish	.....	216	1085	880	228	.....	602
Spinach—							
Spring sown	250	316	.....	.....	680	.....	415
Fall sown	.....	.....	875	133	.....	.....	504
Pumpkin—							
Small Sugar	504	973	.....	.....	.....	.....	738
Squash—							
Hubbard	168	400	.....	.....	.....	.....	284

TABLE VIII

YIELD OF SEED OF ANNUAL VEGETABLES—Experimental Plots at Lewiston

Kind	POUNDS PER ACRE					
	1920	1921	1922	1923	1924	Average
Sweet Corn—						
Golden Bantam	1800	.....	.....	1510	.....	1655
Pop Corn—						
Australian Hulless	900	.....	.....	901	.....	900
White Rice	1166	.....	.....	.....	.....	.....
Lettuce	.....	.....	.....	183	342	262

CORN

In 1922, 195,000 acres of sweet corn were grown in the United States. That same season 8,749,000 pounds were produced for seed from 7,405 acres. The average yield per acre was 899 pounds. At the Idaho experiment station the average was approximately 1500 pounds.

In producing seed corn, one must exercise the greatest care to avoid mixing the crop. Sweet corn should not be grown near field corn, nor should two varieties be grown in the same field.

Corn will do best on a rich soil. The preparation of the soil should be

the same as for other vegetable crops. Seed should be planted in rows three feet apart each way, allowing from three to four plants to the hill. Planting may be done in most sections of Idaho after May 15. Cultivation is the same as for field corn.

The value of seed corn depends largely upon the method by which it is gathered and cured. Ordinarily harvest should not begin until kernels reach the dough stage. Then the stalks should be cut and placed in small shocks. As soon as the stalks are well wilted, which usually occurs in from three to six days, the ears should be husked and dried in an airy place.

In many sections of Idaho, where there is very little rain in the fall but where drying winds are prevalent, harvesting may be delayed until the corn is nearly cured. The crop should then be gathered, husked and spread out to complete the drying. To cure corn properly it is essential that the ears be freely exposed to the air until the kernels are dry. A common practice is to spread the corn out in open sheds or barns or scaffolds formed of slats, so that the air can circulate freely. The corn is spread not more than two to three ears deep.

As soon as the corn is dry it is shelled by machine, and run through a fanning mill. Before sacking, it is advisable to spread thinly on the floor and stir from time to time. If placed in sacks too soon, corn is likely to mould.

CUCUMBERS

Cucumbers can be grown as a seed crop in any of the trucking areas of Idaho. The crop is fairly easy to grow and ordinarily is very remunerative. As different varieties cross readily, it is advisable not to grow more than one variety during a season.

To grow a crop of cucumber seed, a well drained sandy loam soil with a southern slope is preferable. Cucumbers require liberal fertilization, hence the necessity of supplying plenty of barnyard manure. This material should be plowed under some little time before planting in order to have it thoroughly incorporated in the soil. Thorough preparation of the soil is essential.

Planting should be done after the danger of spring frosts has passed. From eight to ten seeds are planted to the hill in rows four to six feet apart each way. After plants are about six inches high, they are thinned to three or four plants to the hill. It requires about two pounds of seed to plant an acre.

As soon as the plants are large enough, they should be given frequent cultivations, until vines fill up the middles. As the ripening period extends thru the dry season, a number of irrigations should be made in

irrigated sections. Water should be used only when needed to keep the plants in a healthy growing condition.

The seed will be ready to harvest when the fruits have turned yellow. The season will vary somewhat in the different sections, but ordinarily most cucumbers will be ready from September 15 to October 1.

In harvest, all ill-shaped fruits and those not characteristic of the variety should be rejected.

There are several methods of removing seed from the fruit. The simplest one is to slice the cucumbers lengthwise, scrape out the seeds, and allow them to ferment in a pail or bucket in order to loosen the mucilaginous covering. This method is suitable when growing on a small scale.

When an acre or more of cucumbers is grown for seed, machines usually are employed to remove the seed pulp. Two kinds, both constructed especially for extracting cucumber, melon and tomato seed, are in general use. In one type the cucumbers are poured into a hopper and crushed between a revolving wooden roller and an adjustable crushing board, then passed into a revolving wire reel which separates the seed. A cider mill can be used to good advantage for crushing the cucumbers.

Another type is six feet long and is operated by a crank on each side. The cucumbers are conveyed by an elevator into the hopper and crushed by two revolving rollers. The pulp passes on to a revolving screen four feet in length which has two canes on the ends of a shaft, forming a beater which separates the seed.

After the seed-bearing pulp is removed from the fruit, it must undergo a process of fermentation or souring in order to remove the seed from the pulp. It will take several days to complete the fermentation. The pulp is poured into barrels or tanks and stirred thoroughly every day in order to keep the seed on top from becoming black To determine whether the seeds have undergone sufficient fermentation, a handful is squeezed. If the seeds separate freely, they are ready for washing.

Seeds should be washed in clear water to separate them from the pulp. A barrel may be used for this purpose. A quantity of pulp is placed in the barrel which should contain several pails of water, and it should be stirred vigorously with a circular motion. This causes the seed to sink to the bottom while the pulp remains suspended. The pulp can then be poured off readily. It will be necessary to wash the seed in several changes of clear water to remove the pulp entirely. After drying, it may be stored in bags in a cool, dry place.

There is no reason why the production of cucumber seed should not become an important industry in Idaho. In 1919 the experiment station produced 200 pounds per acre. The average for the United States over

a period of years is only 180 pounds per acre. Much of the seed now is produced in New York, Michigan, Iowa, Kansas, Nebraska and Colorado.

LETTUCE

In 1922, there were 1,929 acres devoted to the production of lettuce seed in the United States, with a production of 856,476 pounds. At present there is very little seed produced in Idaho, altho' it may be grown successfully in any section of the state where head lettuce is grown commercially. Whether the crop is grown for seed or for salad purposes, cultural methods are similar. Lettuce requires a cool climate for best development.

To produce a good yield of seed, a well pulverized, mellow soil is desirable. A soil which has been enriched with well rotted manure or which has grown a crop of alfalfa or clover for several years is ideal for seed production. Seed should be sown as early in the spring as possible in rows 18 inches apart, and later the plants should be thinned to 12 inches apart.

In order to mature seed properly, the soil should be kept fairly moist during the growing season. As lettuce responds to careful cultivation, close attention from seeding to maturity is required in growing a seed crop. When the plants begin to head it is necessary to go over the field and eliminate all those which fail to form typical heads, those which do not head well, and those which shoot too quickly to seed. Since lettuce crosses readily, all other varieties must be eliminated.

With a little experience, one can ascertain easily when the plants are ready to harvest. The crop usually ripens between August 1 and 15 in the warmer valleys of the state, while in the cooler sections it will be somewhat later. When the seed heads begin to swell and turn yellow it is time to harvest. Since the entire field ordinarily will not be ready to harvest at the same time, several cuttings may be necessary. The plants are cut by hand and placed in small piles on canvas, as the seed shatters readily. It will be several days before the plants are dry enough for threshing. An ordinary threshing machine in which some of the teeth have been removed will thresh the crop very nicely. If only a small area is grown, the seed may be flailed out. It is cleaned finally in a fanning mill. The average yield per acre in the United States is 349 pounds. The yield at Lewiston under irrigation for the year 1924 was 342 pounds, while at Moscow under non-irrigated conditions 143 pounds was produced. This seed is of excellent quality. The average wholesale price per pound, according to the United States Department of Agriculture, for the years 1917-1922 inclusive, was 77 cents.

RADISH

The radish may be found in almost every home garden. It is easily grown and is ready for use within a short time. Seed must be produced to meet this demand. The area devoted to the production of radish seed now varies from 2,000 to 10,000 acres annually.

While a good crop of seed can be grown on any type of soil, best results are secured in a rich, sandy loam. The preparation of the soil should be about identical with that described for the other root crops. Since the radish is a cool season crop, the seed may be sown in the spring as early as the ground can be prepared. The seed is sown in drills three feet apart and later the plants are thinned out to four to six inches in the row. During the season, the field should be rogued.

Seed of winter varieties is sown in August, and later in the fall roots are dug and wintered over in trenches as beets are. In early spring, the roots are set out four to six inches apart in rows three feet apart. The crop is usually ready to harvest in July or early August. Harvesting should commence when the bulk of the pods are ripe. The stalks may be cut with a scythe or with a mowing machine, then forked into piles and allowed to dry. The pods are very tough, hence the necessity of allowing stalks to become thoroughly dry before threshing. The seed may be threshed with a threshing machine or it may be flailed out. It is cleaned in a fanning mill.

SPINACH

Spinach has become an important crop in many of the gardening sections of the South. It is also the plant most extensively grown for greens in home gardens of the United States. The popularity of spinach is due to the fact that it is rich in iron and vitamins, and its use is advocated quite generally by physicians, particularly for children's diet. In 1922, 655 acres were devoted to seed production. The average yield of seed per acre is approximately 500 pounds but some sections produce as much as 1,000 to 1,500 pounds per acre.

While spinach is classed as a biennial, the plant will produce seed the first season under Idaho conditions. The seed may be planted in fall or spring altho the fall planted crop will produce the highest yield of seed. Seed is planted about the middle of September in rows two to three feet apart, and the plants are later thinned to four to six inches apart in the row. The fall sown crop needs no protection during the winter. The spring crop should be sown as soon as the ground can be worked. It should be handled as lettuce is. Spinach produces male and female plants, hence only the female ones will produce seed.

When the plants begin to turn yellow, they are cut with a scythe or a mowing machine and placed in piles to dry. When thoroughly dry they

are ready for threshing, which may be done either by hand or with a threshing machine. As the seed is produced in bunches it may be necessary to hand rub in order to break up the clusters if the seed is flailed out. When threshed in a machine this operation is not necessary. The seed is finally cleaned by running thru the fanning mill.

Fig. 9—Spinach.

PUMPKINS AND SQUASHES

Cultural methods for winter pumpkins and squashes are the same as for cucumbers. Since pumpkins will mix with each other as well as with summer squashes, all the variety types within these two crops should be separated by at least 500 to 600 feet. Seed should be planted soon after May 20 in rows six feet apart each way, and with eight to twelve seeds in each hill. They are later thinned to three or four plants.

Pumpkins and squashes should be harvested after the first frost. It is customary to store the crop in a barn or shed for a week or two to give the fruit sufficient time to mature before removing the seed. Removal is accomplished by cutting open the fruit and scooping out with a heavy spoon.

The pulp can be removed without fermentation. White seeded varieties become discolored, if subjected to this process. It is a good plan to wash seed the day it is removed. The pulp is placed in a tub or barrel and mashed until in a mushy condition. Water is poured in and the mass is stirred vigorously to separate the seed from the pulp. After the seed has been thoroughly cleaned it is spread on trays to dry. At the Experi-

ment Station as much as 500 pounds of sugar pumpkin seed per acre has been produced. The ordinary acre yield for both pumpkins and squashes varies between 200 and 300 pounds.

DANGER OF MIXTURES IN GROWING VEGETABLE SEEDS

There is danger of cross pollination when two varieties of the same crop are grown close together. Therefore, great precaution is necessary. In most cases, only one variety of a given kind can be grown on a single farm, or often even in a single neighborhood, even though the other patch is a long distance away. Corn is the most conspicuous example of this tendency. Radishes cross very readily as do turnips and rutabagas. Rutabagas are reported to cross with cabbage and other related crops; lettuce varieties will cross if grown close together, but owing to the heaviness of the pollen, will not cross over long distances. Varieties of winter squashes are liable to cross as are also those of pumpkins, but pumpkins and winter squashes will not intercross. Pumpkins and the various types of summer squashes, however, will cross with each other. Cucumbers cross with other cucumbers; muskmelons with other muskmelons, and watermelons with other watermelons, but these three will not intercross with each other nor with pumpkins or squashes. However, citrons will cross with watermelons.

SELECTION AND ROGUEING

Because of the danger of cross-pollination, of deterioration, or of running out of varieties, the question of selection and rogueing is important No man should engage in garden seed production unless he will take the pains to study well the types of various strains he is growing and will carefully eliminate all plants not conforming strictly to the type being grown. That is, he must rogue his fields systematically. This question is related intimately to the finding of a market. Unless a seed grower will eliminate undesirable specimens from his fields and will take the pains to select for a particular desirable type, he will always have difficulty in disposing of his crop to reputable seedsmen for remunerative prices. On the other hand, if he will exercise such care and begin in a small way, he will be able to build up a reputation for reliable seed, and will have no difficulty in disposing of his crop.

In the beginning the essential thing is to start with absolutely pure seed of the strain or variety being grown. Then by careful watching thruout the season, any specimens that do not conform to the true type can be pulled out. In the case of those biennials that are pulled and stored over winter, a good opportunity is afforded for selection at the time of sorting the roots before planting.

The grower can, if he desires, often build up a superior strain in some crops by carefully selecting a limited number of plants that are exceptionally true to type and that give a high yield. The seed from each plant is saved separately. The following year single roots are planted side by side, the seed from each specimen being used to plant a row. Some rows are also planted with seed used for the regular seed crop, so as to compare the yields resulting from selected and unselected plants. Some rows will show better yields than others and these can be made the basis of new strains. In the case of annual vegetables that readily cross-pollinate, it will be necessary to keep in reserve some seed from the original selected plant to use as the basis of the new strain. The seed produced by these rows, planted side by side, would be badly mixed and of no value in selection.

Some seed crops require special systems of selection to prevent deterioration. This seems to be especially true of the sugar beet. The ordinary farmer cannot intelligently select for high sugar yield and unless such selection takes place there is danger of a reduction in the sugar content of the roots. For that reason sugar beet seed growing will always be conducted mostly by large firms able to afford the chemical equipment necessary for intelligent selection. Such firms in Europe, however, send out the stock seed resulting from chemical selection to small farmers for use in growing the commercial seed crop. This custom could be widely extended in some of our sugar beet seed growing sections. Inasmuch as we are annually importing an average of 13,800,000 pounds of sugar beet seed, it is evident that there is room for considerable expansion of this phase of the industry.

CONCLUSION

A comparison of experimental results obtained in growing seed with table No. IV indicates that there is a field in Idaho for expansion of certain phases of the seed growing industry. This table indicates that we import considerable quantities of beet, carrot, parsnip, radish, spinach, turnip, and rutabaga seed, and the data show that these crops may be profitably produced for seed in Idaho. The data further indicate that some other garden seeds give as good or better yields in Idaho than elsewhere in the United States. Sweet corn, onion seed, and possibly cucumbers, and pumpkins are in this class. For these reasons garden seed production should become more and more important in those sections of Idaho that are adapted to any of these particular crops.

SUMMARY

This bulletin treats of the growing of a number of vegetable seed crops over a several year period and gives definite information as to methods of handling each crop.

From experimental data presented herewith, it is evident that there is an opportunity to develop this industry in the state. It is, however, a specialized enterprise and to make a success one must have training and information. For this reason, the beginner is advised to begin on a small scale and develop gradually.

Careful rogueing is absolutely essential in the production of high quality seed. To prevent danger of mixture two varieties should not be grown close together.

Since biennial vegetables require two years to produce seed, different methods in regard to planting and wintering over were tested out. Beets can best be wintered over in pits, while turnips produce best yields from young plants wintered over in the ground.

Climatic factors influence the yields of different crops each year.

The average yields per acre of sugar beets, carrots, cabbage, corn, pumpkins and radish in Idaho is well above the average for the United States as a whole.

The size of the onion bulb greatly influences the yield of onion seed. The larger bulbs have given the best results over a three-year period.